Geol. Survey

State of Illinois
Department of Registration and Education
STATE GEOLOGICAL SURVEY DIVISION
John C. Frye, Chief

EARTH SCIENCE FIELD TRIP

GUIDE LEAFLET

METROPOLIS AREA

MASSAC, POPE AND JOHNSON COUNTIES

PADUCAH, BROWNFIELD, VIENNA AND LA CENTER QUADRANGLES

Leaders
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Urbana, Illinois
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GUIDE LEAFLET 1959A HOST: METROPOLIS HITH SCHOOL

METROPOLIS FIELD TRIP ITINERARY

0.0	0.0	Assemble caravan on Catharine Street in front of Metropolis High School, heading south.
0.1	0.1	Stop, Catharine and 9th Streets.
0.3	0.4	Stop, Catharine and East 5th Streets (Route 45).
0.1	0.5	Stop, continue ahead.
0.1	0.6	Slow, turn right on East Second Street.
0.1	0.7	Slow, turn left at Girard and East Second Streets.
0.1	0.8	Caution, railroad, turn right immediately beyond.
0.1	0.9	STOP 1 - North bank of the Ohio River.

Recent history tells us of many pirates who preyed upon early settlers moving up and down the Ohio River. Geological history tells us that the Ohio itself has indulged in a little piracy. Near the end of Pliocene time, the interval of geological time that preceded the Pleistocene or "Ice Age," the major rivers that now drain southern Illinois and surrounding regions were present, but along somewhat different courses than they now follow. The Mississippi followed roughly its present course along the western side of southern Illinois to a short distance north of Thebes in Alexander County, where it turned abruptly into Missouri. The Ohio was only a small stream, heading in western Ohio, until it united with the Wabash north of Shawneetown in Gallatin County. From Shawneetown the Ohio followed its present course to Bay City in Pope County, where it swung to the west and followed a course through the lowland area along the southern base of the Shawnee Hills now occupied by Cache River and Bay Creek. At the time the Ohio flowed along the Cache River-Bay Creek lowland, the Cumberland and Tennessee Rivers united in southern Pope County or western Kentucky, and flowed westward along the present valley of the Ohio. The Mississippi and Ohio then united somewhere to the south of their present junction in Missouri or Arkansas. The courses of the Preglacial Ohio, Mississippi, Tennessee and Cumberland Rivers are shown diagrammatically near the back of the itinerary.

Although none of the four great glaciers which advanced into Illinois during the Pleistocene or "Ice Age" reached the Metropolis area, they were directly responsible for changing the preglacial drainage to its present form. During the early stages of the Pleistocene epoch the Mississippi abandoned its preglacial course through Missouri, and eroded a deep gorge in the bedrock near Thebes. The Ohio, Cumberland and Tennessee, as far as we can tell, maintained their preglacial courses until the Illinoian (Third) glacial stage. During the Illinoian stage, the Ohio cut through the narrow divide which separated the Ohio from the Tennessee-Cumberland and captured the valley which it occupies today.

These major drainage changes which occurred during the Pleistocene were probably caused by filling and choking of the preglacial valleys with outwash sands, gravels and clays from the melting ice sheets. The present courses followed by these major rivers are also shown near the back of the itinerary.

0.0 0.9 Turn right on Metropolis Street.

0.2 1.1 Stop, continue ahead.

0.1 1.2 Stop, turn right on East 5th Street, Route 45 East.

0.7 1.9 Slow, caution, railroad crossing.

0.2 2.1 Bear left, on Route 45.

0.3 2.4 Entrance to Fort Massac State Park on right.

This is the site of an early French Fort said to have been built near 1759. According to Bonnel, Smith in his History of Southern Illinois relates the following about Fort Massac. "It seems to have been there or was located there during the French and Indian War, which lasted from 1754 to 1763. One date for the fort's origin is 1759. The French surrendered the Fort to the British in 1763. George Rogers Clark arrived at Fort Massac on his famous trip to Kaskaskia. In 1804, Aaron Burr stopped for four days at the fort visiting General Wilkinson who was there with a party of forty United States troops."

The spot occupied by the original wood stockade has been excavated by State archeologists. Posts outline the compound and buildings.

0.2 2.6 Caution, Railroad Crossing.

0.6 3.2 Crossing Massac Creek.

1.9 5.1 Slow, turn left on Highway 145 (north).

4.7 9.8 Note the flat floodplain of the streams. The valleys in this region are alluviated, that is, they have been filled by clays and sands deposited in back-water lakes during the Pleistocene.

1.6 11.4 Note the flat valley and the brown gravel in the stream.

1.0 12.4 Slow, turn right into gravel pit.

0.1 12.5 STOP 2. Gravel Pit in the Lafayette Formation.

From the Upper Cambrian to near the end of the Mississippian Period, Illinois was submerged beneath great interior seas in which large quantities of limestones, sandstones and shales accumulated. Late in Mississippian time the land began to rise and sink intermittently, a condition which lasted until the end of Pennsylvanian time. Great quantities of sand and muds were brought into the Illinois basin during this time, often turning the region into great swampy flat coastal plain. It was

under these conditions, which frequently existed during the Pennsylvanian Period, that our great coal deposits were formed, even though much of the Pennsylvanian se. iments were deposited under marine conditions.

In Illinois we have no rocks of Permian, Triassic, or Jurassic age, and we have no information to even relate to us the geologic events that transpired during this long geologic interval.

The rock or red sand at the base of this gravel pit is thought to be of Cretaceous age and the overlying brown iron stained, cross bedded, rounded chert gravel has been correlated with the Pliocene system of rocks. There may be question as to the age of this gravel, for it has not been actually correlated with true Lafayette material, so we will call the gravel in this pit "Lafayette type" and tentatively call it Pliocene.

You will find chertified Mississippian fossils in this gravel, which gives an indication of the source of some of the gravel. The pebbles are highly polished and are coated with a thin veneer of limonite. This gravel is found in valley deposits and also on the tops of hills as we find it here, indicating that there must have been a great quantity of this material. The distribution of Cretaceous and Tertiary sediments in the middle Mississippi valley is shown near the back of the itinerary.

The pit is blanketed with loess of Pleistocene age which was picked up from the present Ohio and the ancestral Ohio in the Cache River valley. One has only to be present on a windy day in early spring to visualize just how this loess was deposited, for dust storms are not uncommon here even now.

Beneath this "Lafayette type" gravel we find the loose red sand which has been called Cretaceous. Geologically we are at the north end of the Mississippi Embayment, which reached Illinois during Cretaceous times. The north end of the Gulf of Mexico reached as far north as this region.

With the coming of Pleistocene and the advances of the glaciers water in unbelievable quantities followed the preglacial valleys and greatly changed the areas adjacent to the streams. It removed great quantities of the "Lafayette type" gravel, and the underlying Cretaceous sediments so that to the north only hill top deposits and remnants are to be found. New valleys were cut, old ones abandoned, valleys filled with later glacial sediments, and of course the loess which is a fine dust, blanketed the surface of all the sediments to a depth of several feet.

Just when in the Pleistocene all this activity took place, we are unable to say. Perhaps the beginning of the Pleistocene was one million years ago, but according to Carbon 14 dating, the last glacier left the United States in the Great Lakes Basin about 10,000 years ago.

The section here is as follows:

	ft.	in.
Loess	8-10	
Gravel, rounded chert pebble to 2" in diameter, with much limonitic clay, cemented in part by limonite. This gravel is grossly cross bedded	20	
Chert conglomerate heavily cemented with limonite		6
Cretaceous, red sand	3	

Return to cars and return to the highway.

Stop. Caution on entering the highway, turn right.

0.8 13.3 Note the Paleozoic rocks far ahead on the north side of the Cache Valley.

0.7 14.0 Outcrop of Chester (Hardinsburg) sandstone dipping 10 degrees to the north. A fault of minor magnitude crosses the road at this spot. For the next 8 miles we will cross several faults or breaks in the bedrock.

0.2 14.2 Outcrop of Chester sandstone (Tar Springs) dipping 20 degrees northwest.

0.4 14.6 Entering a tributary to the Cache Valley - note the flat alluviated valley floor.

1.5 16.1 Erosional remnant in Cache Valley - east side of the road. An east-west fault crosses the road here as well as facing on the south side of this low hill.

0.8 16.9 Bay Creek Ditch.

0.3 17.2 Small terrace that has developed since Cache Valley was abandoned by the Ohio River.

1.0 18.2 STOP 3. Discussion of the Cache Valley.

The Cache Valley is one of the most impressive physiographic features in the State. The origin of this broad valley was discussed at Stop 1. At this point the valley is about 3 miles wide. The north valley walls are eroded in Paleozoic rocks and are much steeper than these on the south which are cut in weaker unconsolidated Cretaceous beds.

The valley is entrenched some 250 to 400 feet below the uplands underlain by Paleozoic rocks. The eastern part is now occupied by Bay Creek, and the western part by the Cache River. Both streams are misfit, that is, they seem to be too small to have eroded the wide valley in which they flow. You will note that the north valley wall is very irregular, and that in many places steep cliffs border it, such as the one we can see from this point to the northwest. Some of the cliffs are clearly the result of down-cutting and lateral erosion by the ancient Ohio, but others, the cliff seen to the northwest, are controlled by faulting. A fault passes along the front of the linear cliff seen to the northwest.

The deposits filling the Cache Valley have a maximum thickness of about 180 feet, and are composed of glacial sands, clays and gravels. Much of this fill is believed to be of Wisconsin age (fourth and last glacial stage), but certainly older deposits are also present. Since good shallow water wells are easily obtained in the valley, few deep wells have been drilled, thus few opportunities for us to study these deposits.

0.3	18.5	Bay Creek. You have noted several depressions in this valley surface, resembling old stream courses. Your observation is correct.
0.2	18.7	Railroad crossing. Danger.
1.6	20.3	Climbing the Paleozoic escarpment. A fault is at the base of the hill and the rocks encountered here are of lower Pennsylvanian (Caseyville group). sandstones with disseminated quartz pebbles.
0.8	20.6	Slow. Note the strongly dipping beds on the right. Dipping from 10-25 degrees northwest. You are crossing a fault zone here.
0.1	20.7	Turn right. Note the steep dipping sandstone and shales - 15-25 degrees to the northwest.
0.1	20.8	Slow - turn right, entering Route 146.
0.1	20.9	Slow. Note the disturbed, folded and faulted sandstone in the cut on Route 146.
0.1	21.0	Turn right, entering Dixon Springs.
0.3	21.3	Turn left, note the strongly jointed rocks in the stream.
0.2	21.5	STOP 4. Lunch stop. Dixon Springs State Park.

After lunch we will take a leisurely stroll south down the stream to see a characteristic feature of the lower Pennsylvanian sandstones, and to take in a little more of the scenic beauty of the park.

The rocks seen on this walking journey are of lower Pennsylvanian age and are referred to as Caseyville. Specifically they are called the Caseyville conglomerates. The rocks consist of coarse cross-bedded quartzose sand in which there are plant fossil impressions and many pebbles of white quartz. This sandstone is resistant to erosion and thereby makes the beautiful cliffs that are found in the park. The park is actually located in a down-faulted block bounded on both sides by faults, and also cross-cut by faults. The faults bounding the west side of the block are only a few hundred feet west of the stream. The down-faulted block is called a graben by geologists.

The nature of the Caseyville sandstones and conglomerates and the undercutting action of the small stream has produced many large boulders. As we walk down the stream note that the number of white quartz pebbles in the sandstone increases rapidly. Lower beds of the Caseyville are characteristically very conglomeratic but the quartz pebbles slowly decrease upward until in the sandstones of the next youngest Tradewater Group they are non-existent.

0.2	21.7	Turn around and turn right.
0.3	22.0	Stop. Caution in entering Route 146.
0.1	22.1	Slow - turn hard right.
0.1	22.2	STOP 5. Discussion of the Dixon Springs Fault problem.

The rock of southern Illinois has undergone folding, faulting, both tensional and compressive, igneous intrusion by dike forming materials and by penetration breccias, and later mineralization, sometime after the end of the Pennsylvanian and before the advent of the Cenozoic. There have been several times of faulting as has been found in the spar mines. Movement along these fault zones has not really stopped. In 1811 the great earthquake of New Madrid, Missouri, resulted in the formation of Reels Foot Lake, Tennessee. This quake was felt in an area of more than one million square miles. Only last fall the Geological Society of America meetings in St. Louis were properly accented by an earthquake in the area while the association president addressed the group on a subject entitled "The Stable Earth."

The Dixon Springs State Park is situated in a graben in the Pennsylvanian rocks. (See illustration of types of faults and structures produced by faulting near the back of the itinerary. This graben is about 3 miles wide and nearly 20 miles long. A faulted block which has risen in relief is called a horst.

Lying to the north for nearly one mile there is a complex of faults of various displacements, ranging from a few feet to several hundred. The Dixon Springs fault has more than 1200 feet of displacement.

The folding and faulting that has taken place in this area is but a part of a larger folded and faulted region, which includes the Rough Creek-Shawneetown zone; the Kentucky River Fault zone; the fault zone of southeastern Missouri; the Ste. Genevieve Fault zone, and with the faulting of the northern end of the Mississippi Embayment connects with the faulting of northeastern Arkansas, and possibly connecting with the faulted and folded region of the Ouachita Mountains and the Arkansas Basin.

We have already indicated that with the folding and faulting that in some areas igneous or molten rock in the form of mica-peridotite rocks came to the surface. In some instances the igneous intrusions came as diatremes or penetration breccia.

It is thought that the mineralization of southeastern Illinois accompanied this time of igneous intrusion and that mineral charged waters deposited the fluorspar, lead and zinc. Occasionally we find joints filled with some of this suite of minerals even in this area. Of course we find such mineralization in southeastern Missouri and northeastern Arkansas.

0.6	22.8	Stop, turn left, note strong dip of sandstone in the ditch on the left. A fault zone is located in the valley on the right.
0.3	23.1	Note the strong compressional jointing in the sandstone on the left.
0.3	23.4	Note the sandstone on the left dipping rather steeply to the northwest.
0.2	23.6	Slow, turn left.
0.2	23.8	Stop, turn left on Highway 146 (west).
0.3	24.1	Slow. Note the dip of the rocks to the southeast in the road cut on the right and left. There are several interesting structures here. Two

[illegible]

[illegible]

faults, a high angle and a low angle, a small anticline, one limb of which is faulted off, and several other features caused by shattering, squeezing, and folding are present.

2.0	26.1	Bridge over Illinois Central Railroad. Note the northward dipping Chester sandstone on the northwest side of the cut. (Tar Springs)
0.3	26.4	Note the outcrops of the Tar Springs sandstone in road cut on right and left.
1.0	27.4	Note the swelling at the base of the trees in the swampy area on the right and left. There are a number of Cypress trees in this low bottom.
0.3	27.7	Slow, entering Grantsburg.
0.1	27.8	Crossing Bay Creek.
1.2	29.0	Note the Tar Springs sandstone in road cut on right and left.
0.9	29.9	Slow. Turn left on Ganntown road. The road is surfaced with Lafayette type gravel which probably came from the pit at Stop 2.
0.4	31.3	Note the outcrop of the Waltersburg sandstone on the left.
1.8	33.1	Climbing a long gentle slope. The slope roughly corresponds to the dip of the Tar Springs sandstone which can be seen exposed intermittently in the ditch along the road.
0.6	33.7	Bear right. Entering Ganntown.
1.2	34.9	Note the outcrop of the Hardinsburg sandstone on the left.
0.3	35.2	Slow. Turn right on limestone surfaced road.
1.1	36.3	The high hill on the far right is capped by the Hardinsburg sandstone. The steep face of this hill is called an escarpment.
0.7	37.0	Slow. Turn right (north).
0.2	37.2	Crossing Clifty Creek.
1.3	38.5	Note the sandstone on the right.
0.2	38.7	Climbing the escarpment of the Hardinsburg sandstone.
0.2	38.9	Slow. Turn right.
0.2	39.1	Slow. Turn left.
0.1	39.2	Slow. Turn right.
0.9	40.1	Turn left and descend hill.

0.1 40.2 STOP 6. Outcrop of Hardinsburg Sandstone along Cave Creek.

From Stop 5 to this point we have been traveling across rough dissected topography underlain by sandstones, limestones and shales which belong to the Chester Series of upper Mississippian age. Here we see one of the sandstones of this series, namely the Hardinsburg, dipping northward at an angle slightly greater than the stream gradient. The sandstone is thin and evenly bedded. It might be used as flagstone for making side walks, flooring patios, and even in building houses.

This outcrop well illustrates the horizontal bedding of water deposited rock strata. Although it is presently tilted to the north, this sandstone was originally laid down in a horizontal position. Movements in the earth's crust, probably sometime after the Pennsylvanian Period and before Upper Cretaceous time, uplifted the whole of southern Illinois tilting the rock strata to the north. As we contimue the trip you will note that all the strata dip northward except locally where altered by faulting.

You will also note that in this region there are a great series of steep sided or asymmetrical hills. These hills are inevitably capped by sandstone. The north slopes of these hills are gentle, conforming closely to the inclination of the bedrock; but the south slopes are steep. This is because here erosion has broken through the resistant sandstone caprock and cut down rapidly through the weaker limestones and shales below. Such ridges are called cuestas, and their steep sides are called escarpments. The map provided shows several of these cuestas trending in a northwest-southeast direction. The most significant cuesta is, however, the one that runs along the northern edge of the Vienna quadrangle, and is formed by the thick sandstones (Caseyville) that lie at the base of the Pennsylvanian. Cuestas and escarpments are characteristic of regions underlain by weak and hard strata that have been slightly tilted.

Cave Creek at this point is flowing to the northwest. A short distance downstream it suddenly turns and flows off in a southwest direction. The sudden turn can be attributed to faulting. The stream flows northwest down the back slope of the Hardinsburg cuesta to the fault zone which trends in a northerly direction. Streams often follow fault zones in this region because these zones offer less resistance to their down cutting action. We will see if the fault zone can be seen in the stream where it makes the abrupt turn to the southwest.

0.2 40.4 Bridge over Cave Creek.

0.4 40.8 Note deeply weathered limestone on the right (Golconda formation).

1.1 41.9 Note outcrop of Tar Springs sandstone on the right.

0.5 42.4 Slow. Turn right.

1.0 43.4 Stop. Turn left on Highway 146 (west).

0.6 44.0 Caution, railroad crossing. Entering Vienna.

0.4 44.4 Stop. Intersection of Highways 45 and 146. Turn left (south).

0.7 45.1 Climbing dip slope of Tar Springs formation.

0.8 45.9 Abandoned quarry in the Glen Dean limestone on the right. The limestone is overlain by the Tar Springs sandstone and shale. A textbook example of lateral gradation from shale to sandstone is shown in the Tar Springs in this quarry.

0.8 46.7 Crossing Dutchman Creek.

0.9 47.6 Crossing Dutchman Creek again. Note how the stream meanders in its vally. A fault zone parallels Dutchman Creek Valley.

0.6 48.2 Note outcrop of Golconda limestone on the left. The Hardinsburg sandstone which overlies it can be seen on top of the hill.

0.9 49.1 Note outcrop of Cypress sandstone on the left. Note that as we traveled south from Vienna the outcropping strata are older and older.

0.8 49.9 Note the beautiful view of the Cache Valley. Here the valley is about three and one half miles wide.

0.6 49.5 Note the bluff of the ancient Ohio River on the right.

1.4 50.9 Note the low ridges in the flat valley.

1.7 52.6 Observe the tall Cypress trees in the swampy area on the far left.

0.1 52.7 Junction of Highway 45 and the Karnak road.

0.4 53.1 Slow. Turn right into the Mermet Quarry of the Columbia Quarry Company. Park cars in area near the office.

STOP 7. Mermet Quarry. PLEASE DO NOT GO NEAR THE PIT FILLED WITH WATER. STAY ON THE EAST SIDE. WE CAN SEE THE ENTIRE QUARRY AND THE FOSSILS ARE MOST ABUNDANT THERE.

The limestone being quarried here is of Mississippian Age and is referred to as the Ste. Genevieve formation. The quarry is now taking approximately 50 feet of rock. The upper surface of the stone is quite irregular and shows the effects of prolonged weathering. Large cavities have developed in the upper surface and are now filled with the red and yellow Cretaceous clays which have overlapped southern Illinois.

As you see, the upper surface of the limestone here varies as much as 40 feet. It appears that the first material which accumulated on this surface was the dark red to black iron bearing formation which has been called the Little Bear soil, this is in turn overlain by a reddish yellow clay, then by a reddish sand, then by a brown chert pebble formation, then by an angular chert pebble zone, then this is mantled by some 6 to 10 feet of loess.

The upper surface of the limestone may have as much as 5-6 feet of residual chert between the limestone and the Cretaceous formations. This chert is laminated and appears to be a result of solution of the limestone and leaving the chert and clay residue.

The entire sequence though considerably reduced in thickness bears certain similarities with the excellent sequence which is to be seen on the road west of Joppa in the Post Creek Cutoff. The consolidated bedrock here is in the Ste. Genevieve while the bedrock in the cutoff is St. Louis.

The upper surface of the limestone offers you an excellent opportunity to collect silicified fossils.

The section here is as follows:

	ft.	in.
Loess	6-10	
Chert pebble zone, angular fragments in a silty clay matrix	4	
Chert pebble zone - rounded brown iron stained	2	
Sand - reddish and clayey		6
Clay - mottled red and yellow		4-10
Earthy iron residual zone. This zone may correlate with a similar zone in the Post Creek Cutoff.		3-8
Chert, residual, probably the product of solution on the upper portion of the Ste. Genevieve formation	4-6	
Ste. Genevieve Formation - limestone, fine grained in part, deeply weathered in upper portion, with siliceous fossils standing in relief		2-6
Limestone, fine grained in part, other parts endothyrid and oolitic, thin and thick bedded	75 at least	

Thank you for coming. See you at Hardin, May 2. .

GEOLOGIC COLUMN - METROPOLIS AREA

Prepared by the Illinois State Geological Survey, Urbana

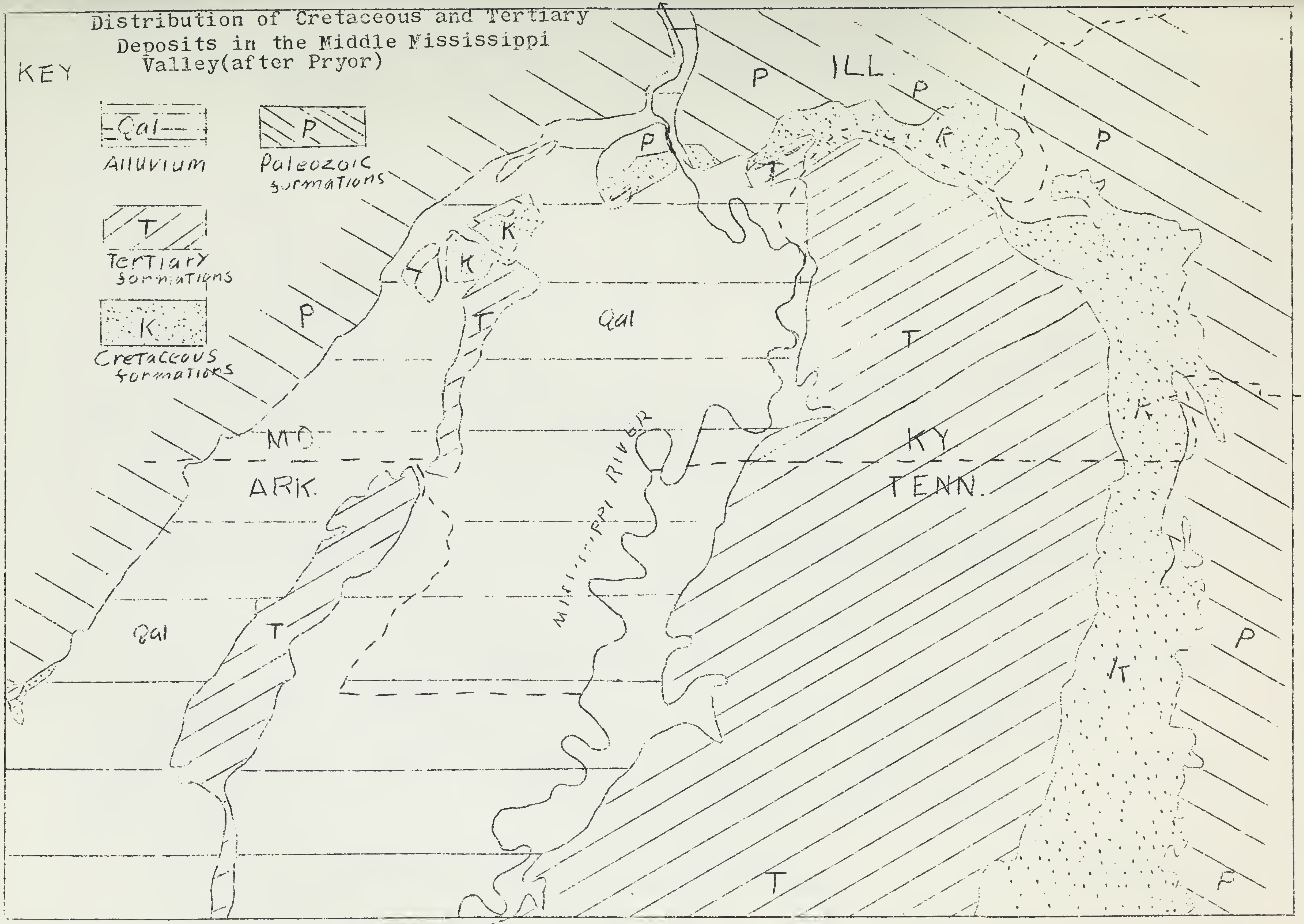
ERAS		PERIODS	EPOCHS	REMARKS
Cenozoic	Age of Mammals	Quaternary	Pleistocene	Recent post-glacial stage Wisconsin loess Illinoian loess Slackwater lake deposits, loess, and slope wash. (Stops 1,2,4)
		Tertiary	Pliocene	Gravels (Lafayette type)
			Miocene Oligocene Eocene Paleocene	Clay and sand
Mesozoic	Age of Reptiles	Cretaceous		Sand, clay and gravel
		Jurassic		Not present in Illinois.
		Triassic		Not present in Illinois
Paleozoic	Age of Amphibians and Early Plants	Permian		Not present in Illinois
		Pennsyl-vanian	McLeansboro Carbondale	Shale, coal, underclay, sandstone, limestone
			Tradewater	Sandstone, shale and limestone
			Caseyville	Sandstone, shale and limestone
		Missis-sippian	Chester (Upper Mis-sissippian)	Alternating sandstone, limestone, and shale formations
			Meramec	Limestone
			Osage	Limestone and shale
	Age of Fishes	Devonian		Not exposed in field trip area
	Age of Invertegrates	Silurian		Not exposed in field trip area
		Ordovician		Not exposed in field trip area
		Cambrian		Not exposed in field trip area

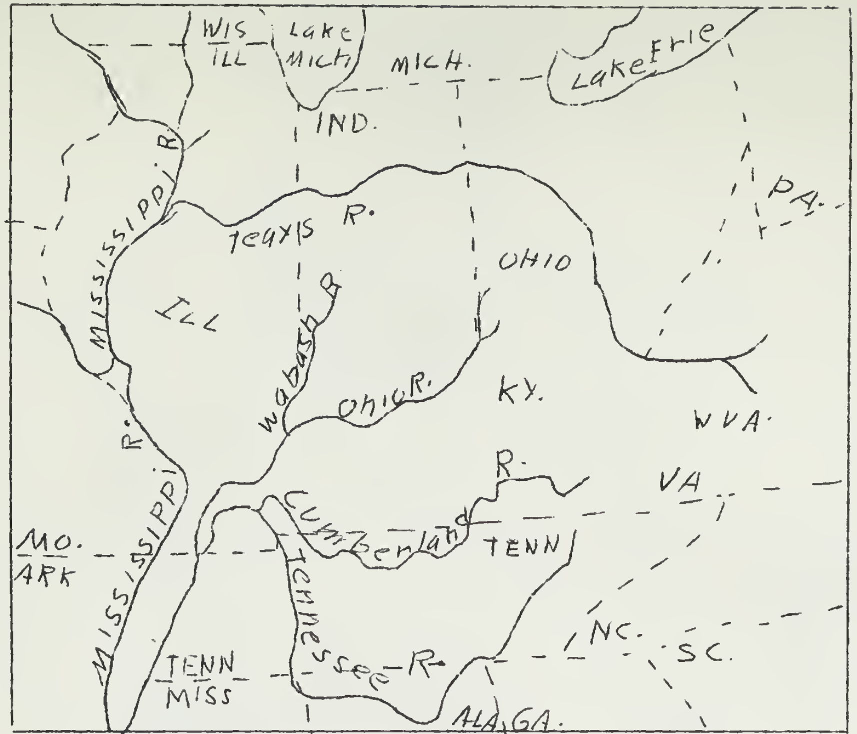
Proterozoic

Referred to as "Pre Cambrian — No data available

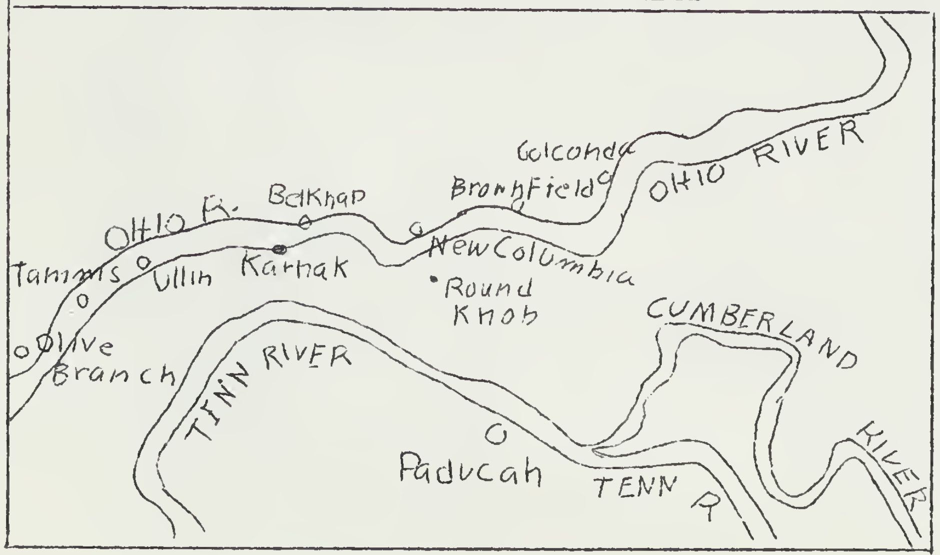
Archeozoic

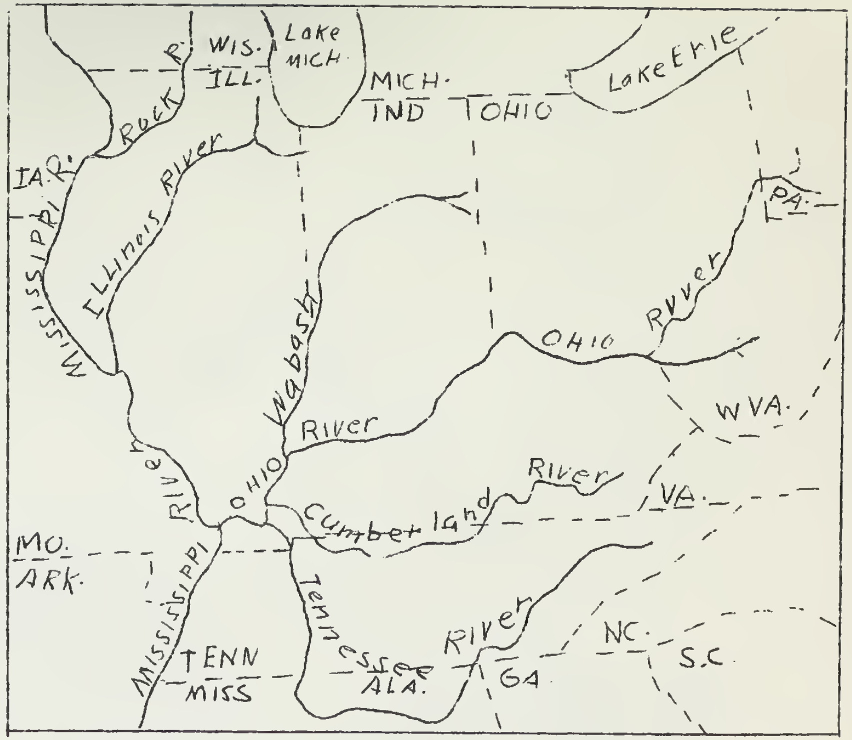
Distribution of Cretaceous and Tertiary Deposits in the Middle Mississippi Valley(after Pryor)





DRAINAGE BEFORE GLACIAL PERIOD





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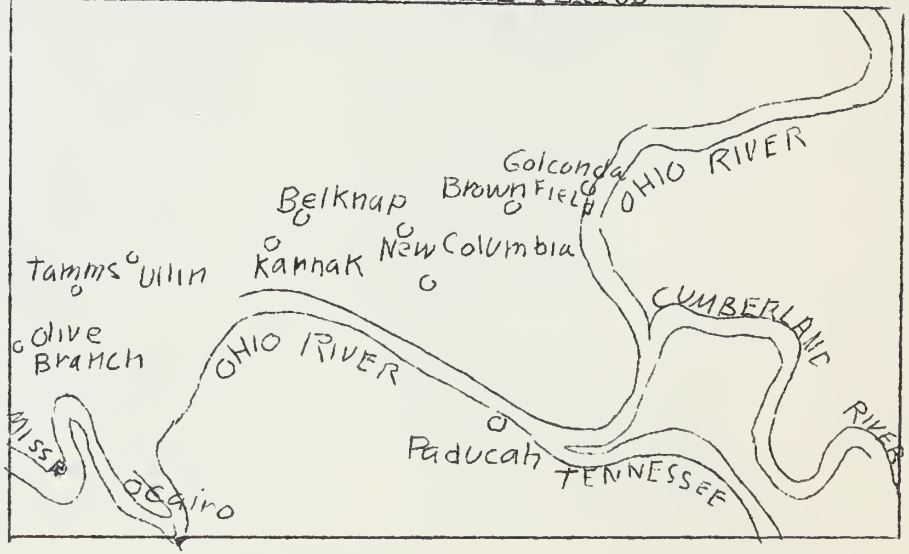
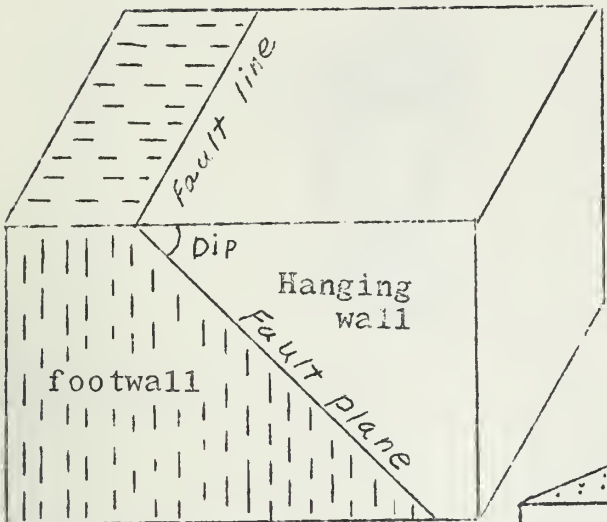
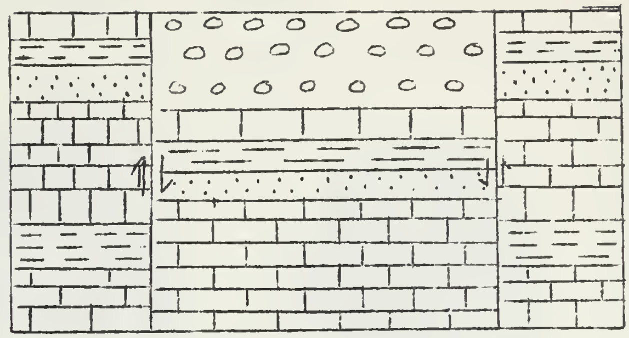




Terminology applied to a fault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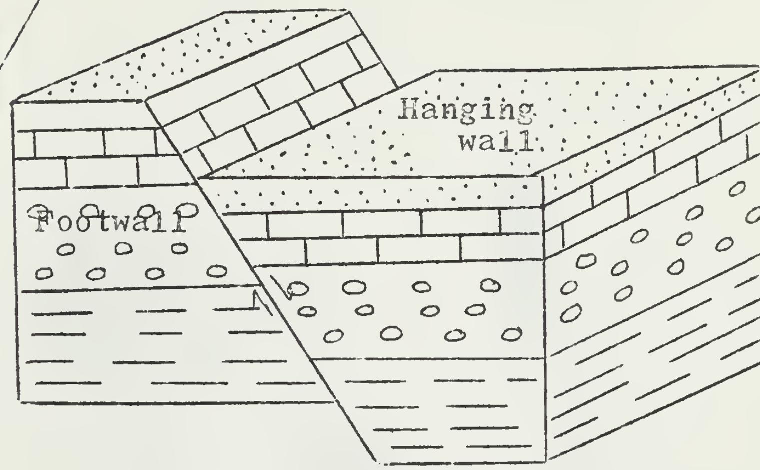
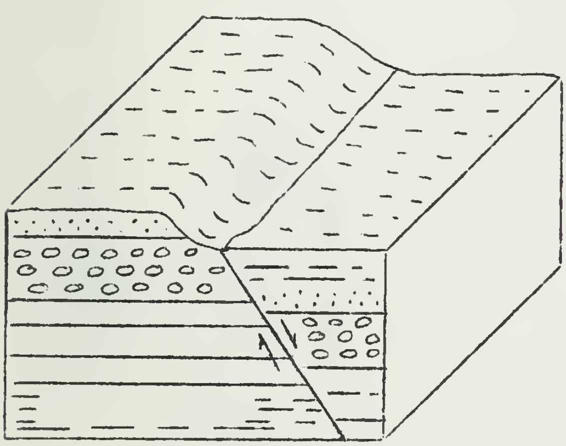
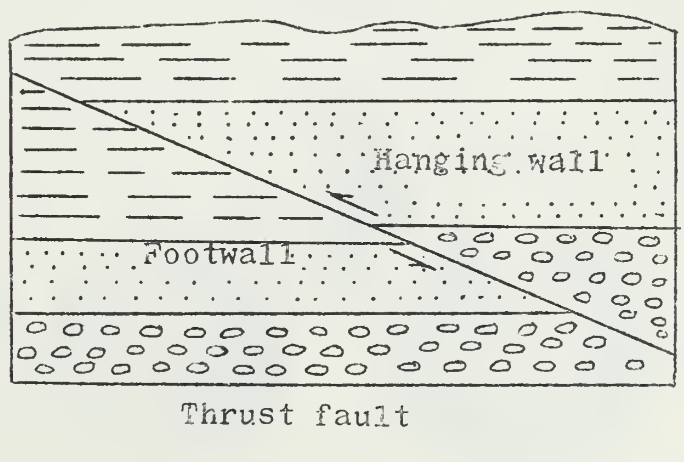


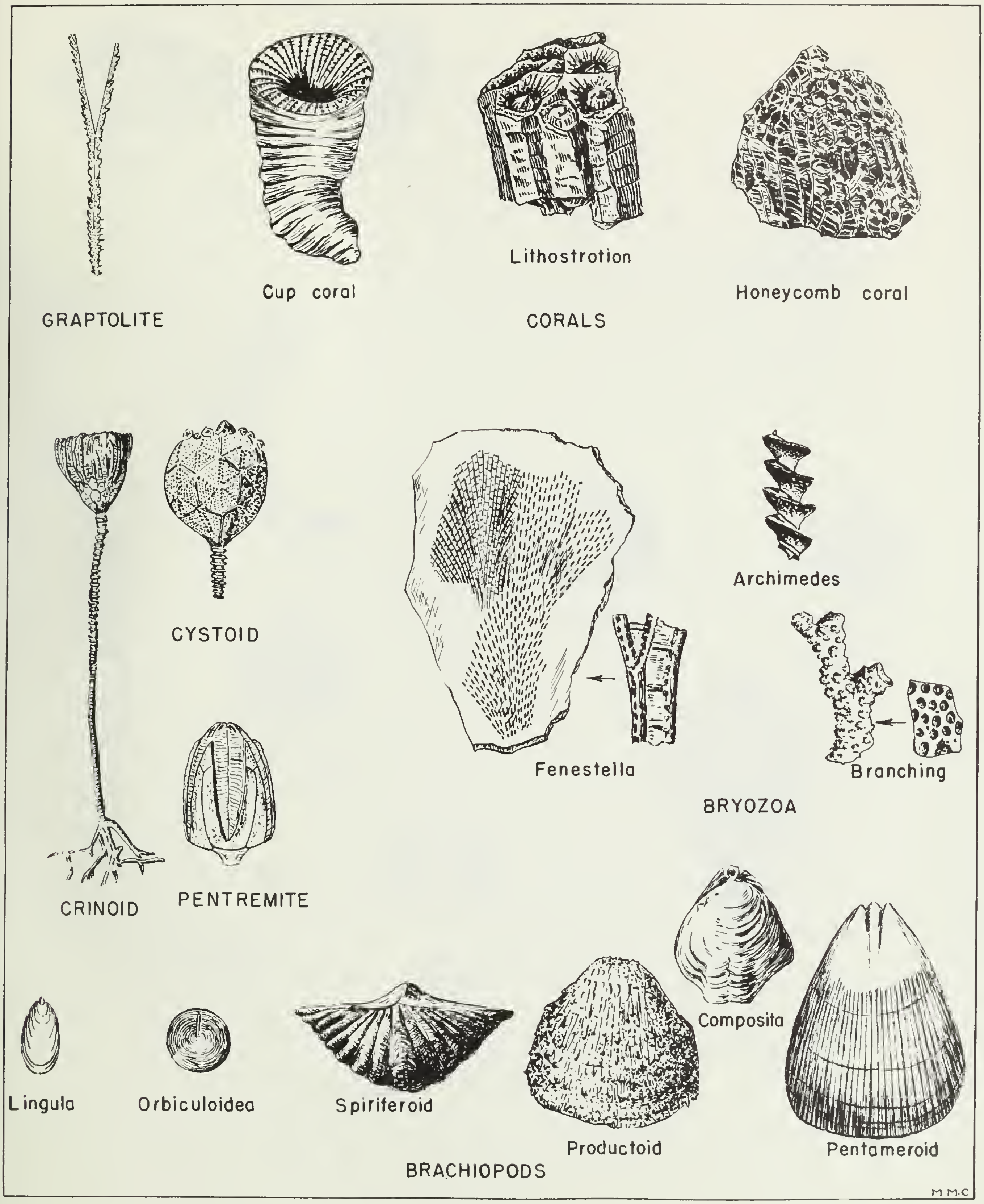
Normal or gravity fault


Fault line scarp

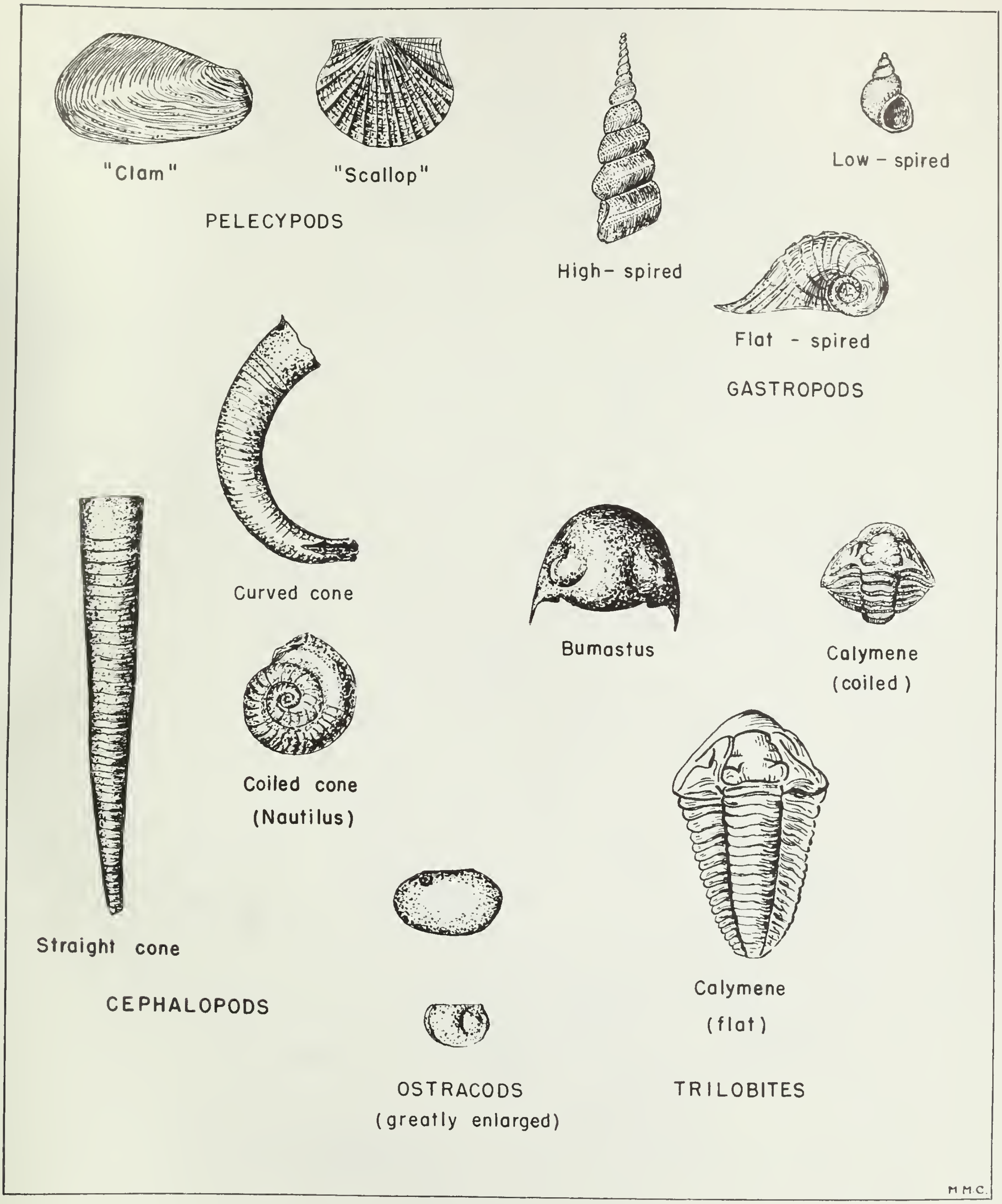


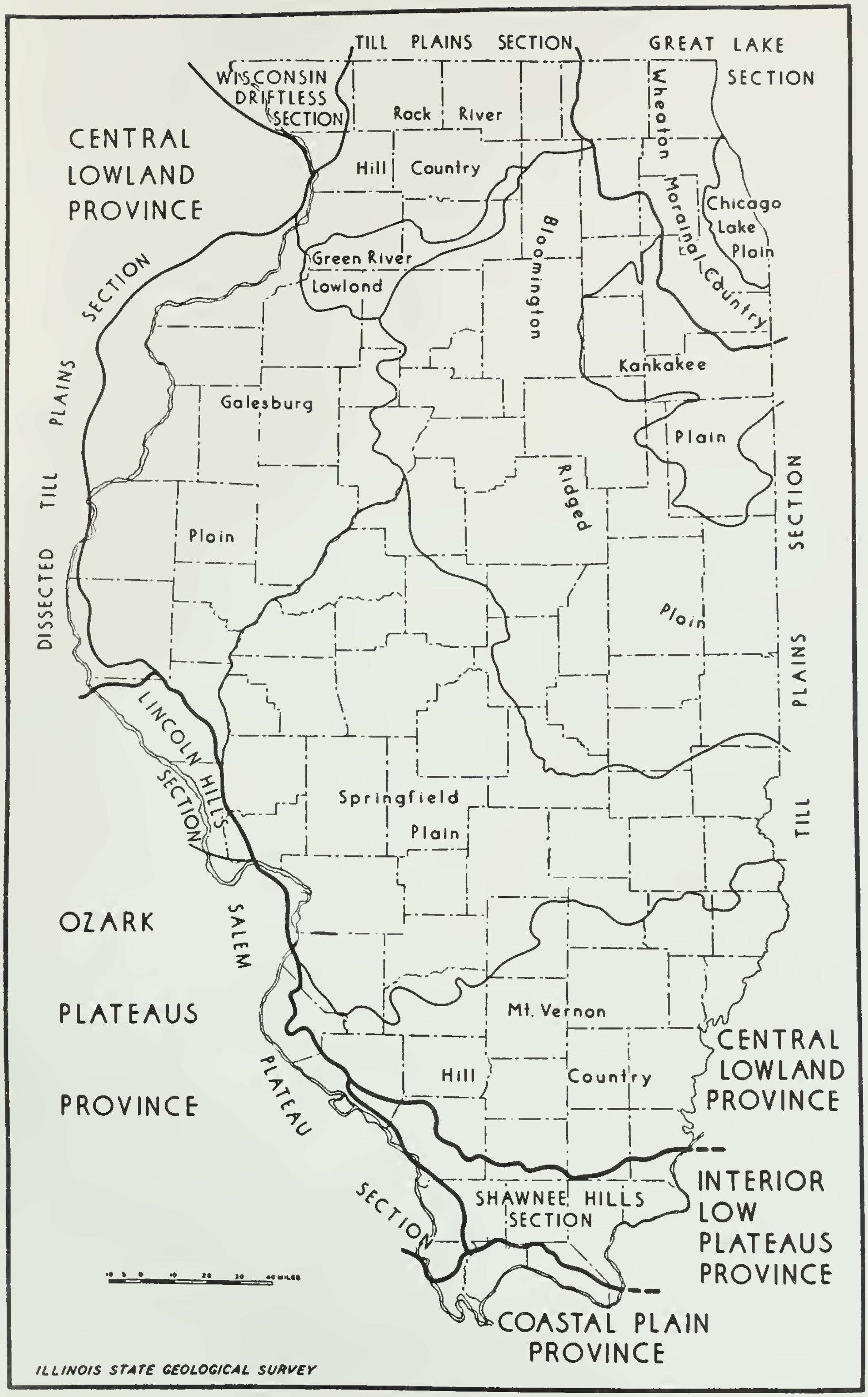
Thrust fault

COMMON TYPES of ILLINOIS FOSSILS



COMMON TYPES of ILLINOIS FOSSILS





PHYSIOGRAPHIC DIVISIONS OF ILLINOIS

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